INEXPLICABLE EXPERIMENTAL CONFUSION

December 8, 2019

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RE: PETITION FOR DECLARATORY RULING[1]
Reply to comments from:
Theodore Rappaport[2] (December 2, 2019)
Nelson Sollenberger, KA2C [3] (November 16, 2019)

EXECUTIVE SUMMARY

Multiple persons seem to be having confusion just understanding the experimental methods and raw resulting data of my published experiments. I'm not principally arguing *conclusions* in the body of this particular filing, I'm trying to focus just on merely understanding the experiments.

Mr. Sollenberger's understanding of the published experiment has so many very serious flaws, that it is difficult at times to understand where he got various assertions. The roles of the locations changed on various days, yet both configurations had success, obliterating Mr. Sollenberger's contention[4] that the monitor enjoyed some tremendous SNR advantage! In his effort to establish the signal to noise ratio experienced by the monitoring station, he confuses data from different receivers/days and misunderstands the reported data, drawing completely faulty SNR computations; he misses the implications of the data captured during the enormous-size-for-HF message. Thus his conclusions related to my work are rendered generally meaningless. Dr. Rappaport inexplicably seems to miss the point of the experiments, which demonstrate that even a substandard monitoring station, inferior in almost every respect to even a Field Day station, much less a competitive contest station, can successfully monitor 900+ mile Winlink Pactor messages.

I discuss proper experimental design, and present 12 published criticisms that appear to indicate a substantial misunderstanding of just what the experiments were, and what their raw data demonstrated.

1 NYU: https://ecfsapi.fcc.gov/file/10242392005642/NYU%20Wireless%20Petition%20for%20Declaratory%20Ruling%20-%2010.24.19.pdf
2 Rappaport: https://ecfsapi.fcc.gov/file/1203160811284/NYU%20Ex%20Parte%20December%202%202019.pdf
3 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf
4 As will be shown, Sollenberger's calculations of signal to noise ratio were mistaken. He appears to have completely missed that the functions of the stations flip-flopped, rendering his conclusion obviously false.

Then I present a retelling of two sets of experiments, in one column presenting the original published material, with additional comments added now in a separate column and show, statement by statement, how the filers appear to have completely misunderstood the experimental conditions and the raw data produced by those experiments. Perhaps later, in other subsequent responses, I'll address more fully the discussions of the meanings of those results. **First let's just properly understand the only available experiments themselves.**

But an overall comment: This is all very surreal. *Anyone* could do these experiments. Far more hours have been spent *arguing over my experiments*, than it takes to simply DO such experiments. I'm mystified why after months of this, we only have ***my*** experiments to discuss?[5]

Therefore:

The most important portion of the filings related to receiving WINLINK over the air is the portion that is MISSING from the filings... *There are just no records of anyone else even trying this but a couple of us.* Not positive, not negative--nothing reported at all. This despite monitoring now being possible with free software, using either a readily-available commercial modem--- or just a Raspberry Pi from Amazon and a soundcard! Here in November and December, world-class experts are reduced to deciphering my hen-scratches, captures, and photos from an old pickup truck at a bus-stop early in September! The FCC might well draw this conclusion:

NO ONE ACTUALLY CARES about over-the-air interception of WINLINK messages
except a very small number of critical filers,
and *not even they* have produced any record of actually trying to monitor WINLINK
(or D-RATS, or FBB, or FLDGI/FLMSG....)
over the air.

INTRODUCTION

I'm completely puzzled by the misunderstandings of reported experimental results that are showing up in various filings as claims that are completely, totally, mistaken. I thought I had fairly straightforwardly and painstakingly described the actual experimental record and results (in plenty of pages!), but statements that are just mistaken are being advanced, that demonstrate a total misunderstanding of the actual experiment. So I will make yet another effort. These are not principally points of disagreement about the interpretation of obscure FCC regulations or arcane technical points about esoteric waveforms --- these are simple everyday ham radio reception experiences that are almost inexplicably being misunderstood.

5 Both of these distringuished gentlemen are far more qualified than I to have created the FC protocol decompression software literally years ago, and to have created the volunteer cadre of diversity receiving stations suitable for advancing the state of the amateur radio art, in monitoring capabilities....years ago.

If people cannot even understand together what are the experimental data, how is it possible to understand the conclusions that can be derived from them? Normally in my experience of a scientific report, the Method and Results are pure facts: *this is what I did*, and *here are the resulting data*. There is typically little argument over what the experimenter did, and what was then measured. The experimenter's CONCLUSIONS based on their data are where the usual argument comes! There really should never be any misunderstanding of what was the experiment and what were the results. But here we seem to have that....and I'm completely mystified. The experiment results recorded seem to provide internal evidence that the statements being made are completely misguided.

Below are some representative claims that I believe represent an almost total misunderstanding of the actual experimental record. Following these statements, I will re-present the actual reported experimental record, and provide an added commentary on that (in a second column) so that any possible further confusion can be alleviated.

Particular attention should be first given to the criticisms made in Statement 1 and Statement 2 of "carefully staged" or "carefully crafted" experiments. These wordings appear curious. Their expressed concerns seem misguided with respect to the scientific process. These are by definition, **experiments,** so by their very purpose, they are indeed "**staged.**" The goal of this kind of experiment is to study the impact of an intervention on a situation. In this case, the situtation is the transfer by Winlink Pactor of a message, and the intervention is to try and capture it as spy or monitoring station. We aren't testing the incidence rate of Winlink PACTOR emails (they are fairly rare); we are testing whether they can be monitored! In this case, the situation, the transfer of dynamically compressed messages, was achieved either by forcing it manually (by a human helper) at one station, or by arranging for automated recurrent polling[6] -- but <u>one has to have substrate (a message being passed) in order to even try the intervention (monitoring)</u>.

<u>The real question is whether the experimental design of the monitoring is widely applicable</u>. Dr. Rappaport astutely and ironically brings the correct concern into proper focus:

> *"...none of which have proven any capability that allows other amateur operators or the general public to decode Winlink data transmissions for ordinary meaning during normal propagation conditions, at sites that are not close to either the transmitting or receiving location"*

However, his asserted conclusion is quite obviously completely false! In this case, the experiment and its results are **obviously** widely applicable, because the qualities and conditions of the monitoring station were actually *horrible*, beyond what would would even serve for a Field Day! They are ***below*** that of most modern amateur radio HF stations; they are ***far below*** that of any competitive contest station. The results suggest strongly that this could be done with even a uBitx kit receiver from India or a web-accessible free SDR. Thus one would have expected praise, rather than criticism, for having created such a "carefully crafted" experiment that is obviously so widely applicable!

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6 The attempt at using radio-only messages to force a transfer failed to cause a transfer. Setting an automated polling interval and strictly limiting the available choices worked to give messages to study.

The following table compares the "carefully crafted" experimental conditions to the "optimal" conditions that a top amateur radio contester would arrange. Far from testing a top amateur contesting station, the carefully crafted experiment tested a rather marginal ham station and antenna -- and still succeeded rather amazingly!

Table 1 -- Conditions of the Experiment Compared to Optimal Conditions. (Almost NOTHING was optimal during these experiments.)

Item	**Optimal Monitoring (Similar to a top contesting station)**	**My Bus-Stop Experiments**	**Comment**
Receiver and Frequency Control.	Modern top of the line digital receiver with 1Hz accuracy temperature controlled oscillator, scanning all important frequencies in a narrow 97.221(b) band segment. Automated recognition of all signals.	No-longer-manufactured inexpensive used ICOM-725. (This was the monitor for Sept. 10 Session #2) This transceiver does not have a temperature controlled oscillator. It was simply set to the a single frequency of a distant RMS. Unknown frequency accuracy. Thankfully, PACTOR modems are able to tolerate a frequency error of 100 Hz or so. I was happy that it worked!  For September 8, the monitor receiver was an ICOM 718, an entry level used transceiver.	This is a clearly older and marginal receiver, rarely even available on Ebay anymore. When available they have typically sold for approximately $350 or less. *Almost any modern amateur radio station purchased within this century could exceed this receiver.*

Antenna	Diversity antennas at each monitoring location (emulating MIMO) so that optimal antenna can be automatically selected when a message is to be copied. Steerable multi-element directional antenna under computer control to greatly magnify the desired signal on higher bands.	For Sept 8, the (monitoring) home station had a multiband non-resonant inverted vee in a tree. For Sept. 10, the monitoring station was the bus-stop, using a home-made 49:1 Balun on FT-240-43 core. Roughly 65 feet of THHN stranded house wire pulled over a nearby oak tree limb after slingshot weighted line. "ground" consisted of a spiral dog-leash support approx 10 inches into the dirt. No other antenna choice available. No directional antenna, no gain antenna.  The blue box at the base of the palm tree is a Carlon electrical outlet box that holds the FT-240-43 49:1 toroid.	For my home station, the inverted vee is an inexpensive non-directional homebrewed wire antenna. At the bus-stop this is an example of one of the simplest antennas that anyone could homebrew. Total cost including the wire is probably under $30.
Propagation	No one can really control this, but SFI values move in cycles and one hopes for something above the all time minimum!	Experiments were conducted during SFI 60-61, **near the all time minimums for worst HF propagation**.[7] At times, fading was a real problem--with complete loss of signal. Thus, serendipitously for the validity of these experiments, they were conducted in some of the worst propagation conditions of all time. The only thing I was missing was a solar storm or an EMP attack to further damage HF propagation...	It would be difficult to ever have again such awful propagation as the sunspot minimum SFI's that these experiments endured.
Computing Resources	Modern top-of-the-line computer with vast	Sept 10: Several year old Lenovo G50 laptop perched in the truck with an Intel	These computers can be had on Ebay

7 https://spaceweather.gc.ca/solarflux/sx-5-flux-en.php

	RAM and with multiple displays	Core 3 processor RAM upgraded to 8Gbyte. Sept 8: Nearly identical Lenovo at home.	for just over $200.[8]
Creature Comforts	Climate controlled, plush adjustable office chair, refreshments available.	2001 Silverado used truck, inconvenient ergonomics, truck turns out to make RFI so had to be shut off, so no AC in Florida sun. No restroom facilities at site..	At the bus-stop, these are worse conditions than any club would choose for Field Day. Almost any home station would be better than this.
PACTOR equipment	Modern 7800 Dragon PACTOR modem for monitoring	In the truck, when monitoring, I had a loaned 7400 Dragon modem; at home I had a several-year old 7800 modem on one station (normally serving the SHARES system), but if memory serves me correctly, I was using the upgraded decades-old PTC-II on the Public KX4Z gateway for these experiments. This modem was previously used by Bud, N0IA.	The PACTOR modem is the most expensive portion of the monitor station. For optimal monitoring it is desired. However, for the penalty of 3-4 dB, a Raspberry Pi/soundcard could be substituted, particularly if a group of stations can assign the best situated station(s) to monitor the desired station, and directional or improved antennas are available.
Diversity	Any modern organized effort to monitor a system of WINLINK, FBB, D-RATS, PACKET BBS's or other stations would want to use internet-connected diversity techniques. Technically speaking, all of this has been possible at least since 2000.[9]	Other than the analytic post-experiment work that I did to show the predicted impact of diversity, I was stuck with single station monitoring and that only with one antenna.	It would be quite easy for a group with anywhere near the dedication and volunteerism of the WINLINK RMS volunteers, to set up a fully capable system far beyond that of my experiment.

8 Lenovo refurbished computer: https://www.ebay.com/itm/Lenovo-G50-80-Intel-Core-i3-5005U-2-0GHz-4GB-RAM-500GB-HDD-15-6-Laptop/254437380383?hash=item3b3da6511f:g:HXYAAOSwws5cGk74

Reviewing these various components of the carefully organized experiment, it is quite obvious that is using very normal capabilities that are either off-the-shelf or even ***old***. Thus the results of the design are obviously widely applicable.

TABLE 2. STATEMENTS FILED THAT I BELIEVE DEMONSTRATE FACTUAL MISUNDERSTANDING OF THE EXPERIMENTAL CONDITIONS OR ACTUAL DATA

My Internal Reference Number	**Statement**	**My Comment**
Statement 1	"ARRL, in its representation to the FCC this month, has instead chosen to rely only on the carefully staged experiments and conditional claims of Mr. Gibby, Mr. Huggins, and Mr. Helfert, none of which have proven any capability that allows other amateur operators or the general public to decode Winlink data transmissions for ordinary meaning during normal propagation conditions, at sites that are not close to either the transmitting or receiving location" [10]	Quite the contrary, I proved that this is actually quite possible, and I did it while receiving signals coming from 900 miles away, and while sitting in a pickup truck at a bus-stop at a true solar minimum.[11] *It doesn't get any more real than that*....this is way worse than Field Day! Please see Table 1 above, and read the experimental record below.
Statement 2	"As shown by Nelson Sollenberger's expert technical report (discussed subsequently), ARRL has disingenuously avoided telling the FCC that the approach it relied upon, those used by Mr. Gibby and Mr. Huggins to show possible decoding of Winlink digital modes such as Pactor, were based on very carefully crafted experiments that provide zero-fading or highly favorable/unusual propagation conditions (e.g. near perfect channel conditions), ..."[12]	An amazing assertion. For the 900 mile receptions carried out from a pickup truck at a Newberry, Florida bus-stop, these statements are completely in error. For the subsequent experiments performed with a Raspberry P[13]i, these understandings are also completely in error. The only possible

9 Gibby: https://ecfsapi.fcc.gov/file/1125713122662/InconvenientData.pdf See discussion of available technology by year, pp. 16-17.
10 Rappaport: https://ecfsapi.fcc.gov/file/1203160811284/NYU%20Ex%20Parte%20December%202%202019.pdf
11 Daily solar flux running 60-61. https://spaceweather.gc.ca/solarflux/sx-5-flux-en.php
12 Rappaport: https://ecfsapi.fcc.gov/file/1203160811284/NYU%20Ex%20Parte%20December%202%202019.pdf
13 Gibby: https://ecfsapi.fcc.gov/file/1125713122662/InconvenientData.pdf

		experiments to which these could apply would be the early experiments **during development of the software during the Summer.**.[14] That's the whole reason that the subsequent real-world experiments were done, carefully recorded, and reported.
	"....and that the dynamic compression methods used by Winlink provide obscured messages to anyone other than the two linked stations when attempting to decode for meaning in ordinary propagation conditions." [15]	My actual experiments conclusively prove that this statement is completely mistaken. A theorem is disproved by a single contrary experiment. This assertion has been disproven not just once, but **multiple times**. Enough such that I got bored doing it.
Statement 3	Mr. Sollenberger concludes "…Winlink transmissions are nearly impossible to intercept,…" [16]	He can certainly "conclude" that (it is a free country and everyone has a right to their opinions), but I've been DOING it *for some months now*.. So I'm unable to understand how it would be considered "nearly impossible."

14 For example: Gibby, Aug. 30 2019: https://ecfsapi.fcc.gov/file/10830048730238/FreeSoftwareToReadWINLINK.pdf and note that by September 4th, I reported that receiving distant stations appeared actually easier. https://www.fcc.gov/ecfs/filing/10904245343229

15 Rappaport: https://ecfsapi.fcc.gov/file/1203160811284/NYU%20Ex%20Parte%20December%202%202019.pdf

16 The author goes on to state: "So many technical experts in the record have explained, time and again to both the ARRL and FCC that Winlink uses decades-old technology that could easily be made to conform to the basic tenets of amateur radio – through the use of unobscured transmissions that can be readily monitored by others over the air – by simply abolishing its use of a dynamic compression table and issuing a software update and the use of a published static compression scheme" **This appears to miss the fact that if the signal disappears (as it did several times during my experiments) you are going to miss packets....and it makes no difference to THAT PACKET whether you are receiving dynamic compressed data or static-compressed data, or uncompressed data: you just LOST that packet and you aren't going to ever know what was in it.** With dynamic compressed data, you will likely not understand "much" of what follows, whereas with static compressed data you might well....but it doesn't change anything about THAT PACKET. This is very easy to prove to yourself at your own desk as I have explained before.

Statement 4	"And he showed in this own experiments that even with fairly strong signals without significant interference, that once a message reaches a significant length, that failure to decode is almost always the result. .... Hence the conclusion by many amateur radio operators, including the ARRL EMA group that, "…Winlink transmissions are nearly impossible to intercept,…"[17] [18] [19]	As documented below, the writer does not appear to understand the experimental conditions reported, thus leading to incorrect conclusions. As the data show, I was often dealing with WEAK signals, down below -80 dBm.[20] How could he possibly know whether there was interference?
Statement 5	"Gibby was successful in decoding messages in Appendices 1, 2 & 3 in that document under the 3 joint conditions: 1) robust coding for the data possibly due to poor SNR at the desired receiver; 2) a strong clean signal at the monitoring station; and 3)fairly short messages with a	The experimental record just doesn't support this gentleman's view of what happened! His calculations of presumed SNR

17 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf

18 https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf

19 The writer himself seems to recognize that the signal levels were NOT that strong in this statement: "SL5 has a bit error rate of 1% at only 6.5 dB SNR, while SL6 has a bit error rate of 1% at only 8.5 dB SNR. **This indicates that the desired link may have had a best case SNR of only about 10 dB SNR** " [emphasis added] He misses that the two stations reversed roles....and speed levels were similar. My experience with these modems is that if they get any good capture at one speed level, they are likely to shift to a higher speed level. They never seem to have the kinds of margins that the writer seems to think they do! If a single monitoring station has even a small SNR edge it will do well; if in a diversity system, one merely needs to have among them one or two stations that just don't have a *large dB disadvantage*. As discussed later, the writer appears to become confused as to which station the reported s-meter readings refer.

20 I'm not quite sure where Sollenberger found the data he claims. In one paragraph he claims, "The author indicates that the signal at the monitoring station sometimes approached S9 which he showed is a fairly strong signal close to -70 dBm on his equipment or approaching 25 to 30 dB average SNR since the noise floor approaches -100 dBm. This suggests that the monitoring receiver may have had about a 20 to 30 dB average SNR advantage over the desired receiver in this test (or at least what SNR was required) since the mode adaptation selected a mode only requiring around 0 to 10 dB SNR, but the monitoring receiver enjoyed an SNR of 25 to 30 dB. " However, the recorded data for Sept 8 session at https://www.qsl.net/n/nf4rc//Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf (linked in the original report) specifically indicates an S4 signal at the **intended location** (possibly -83 dBm) --and a perfect copy. at the monitoring location, where I have no records of the signal level. The author provides no explanation of the asserted -100 dBm noise floor. [For the ancient Icom 725 that I watched in the truck, the only available s-meter calibration at the low end on 40 meters indicates S1= -90dB; I have no data lower] **On Sept 10, the functions reversed -- and success was still achieved.** Had the monitor (on Sept 8) experienced such an enormous advantage as the writier asserts (without any proof) it would appear there would never have been any missed packets, based on the curves the writer himeself provided, **and one of the two sessions would have completely failed due to the assymmetry!** The actual experimental report includes a vague summary (in addition to the specific note for Sept 8 intended recipient): "N5TW would generally have a reasonably strong signal on 20 meters, but never above S9." This came from my observations in the truck, and of course is highly time-dependent. Mr. Sollenberger's claim that the signal "approached S9" apparently miscontrues that general summary statement.

	few lines of text."[21]	advantages are completely mistaken, driven by misunderstandings of the experiments. See later.
Statement 6	Taken together, Gibby's experimental results over-the-air on 20 meters (but with **significant control** of the overall situation).... [22] (emphasis added)	If I had significant control -- I would have arranged for a far more optimal condition, as shown in Table 1. That wasn't the point. The point was to create a very reasonable situation that any amateur could re-create or exceed, and demonstrate monitoring. This was achieved rather amazingly.
Statement 7	"Together, the Gibby and Huggins experiments are consistent with and confirm the issue that extreme SNR advantage or other similar conditions/constraints are needed to successfully decode Winlink over PACTOR-3 messages " [23] [24]	Since the experimental data themselves in my bus-stop case demonstrate precisely the opposite of an "extreme SNRadvantage" Below I explain that Sollenberger appeared to confuse various days' results, and misinterpret signal level comments, while missing actual recorded data.
Statement 8	Surely there were multiple attempts to send the longer messages and all failed in these experiments. [25] (This statement was a middle sentence from the paragraph of Statement 4, but it is so wild of the mark, it is presented separately here for adequate discussion.)	A truly fascinating assertion. **Simply read through the published records.** The experimental record of September 10 (2nd trial)[26] demonstrates exactly ONE

21 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf

22 https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf

23 https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf

24 I believe there are many, many more incorrect conclusions by this author in this cited paper, but I'm going to try to restrict this filing to just dealing with complete misunderstanding of the experimental record.

25 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf , p 14.

26 Gibby: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf see Section Two, Section Three, and Appendices 2-4.

		attempt to send Washington's Farewell Address.
		
		Automated CMS checks were set to occur every 15 minutes --- but that didn't always occur! My GMAIL "sent" folder (see Figure below) **shows that this long message was sent precisely ONCE to Winlink--a summary of the day was sent next..**
		
		GMail Test 3 -- record doesn't mention this one so I can't say what happened. I could have fouled this up multiple ways.
		
		Test 4 -- captured perfectly and presented in Appendix 2 of that day's work;
		Appendix 2 (date-stamp)
		`Date: 2019/09/10 19:32`
		
		Test 5 -- Captured partially and presented in Appendix 3 of that day's work
		`Appendix 3 (date-stamp)`
		`Date: 2019/09/10 19:39`
		
		Test 6 -- Washington's Farewell Address -- partial capture, on its *only* trial shown that day, and **later analysis showed diversity reception would have captured the entire 37,000 character message--<u>on the first try</u>!**
		Appendix 4:
		`MID: Y275JQ0NZ01E`
		`Date: 2019/09/10 20:13`
		
		The data are *there*. The speculative assertion is completely false.

		Getting these emails to even transfer in an automated fashion to allow me to monitor elsewhere, was quite an effort. You had to sit there and wait and wait and wait, hoping that the other two stations would begin a transfer.

Sent Messages from My GMAIL Sept 10: [screen capture performed Dec 5 2019]

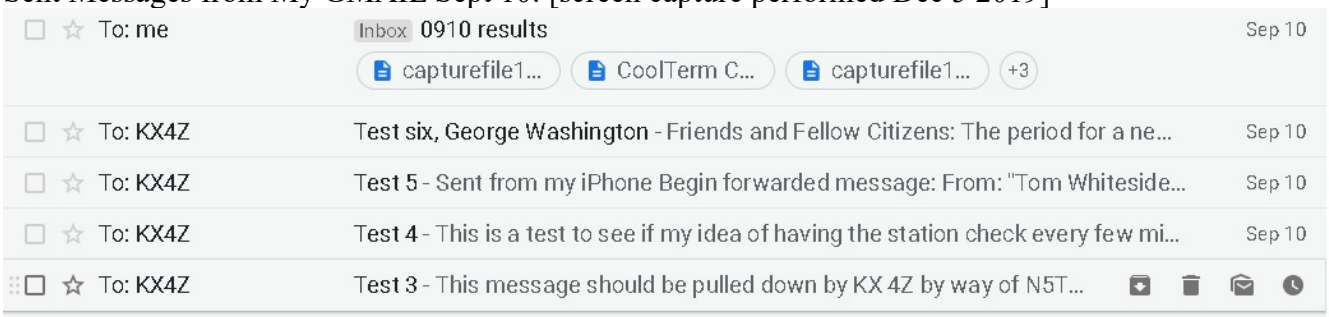


FIGURE 1 GMAIL "sent" record including the George Washington item, supposedly transmitted many times.[27]

Table 3. Attempted Detailed Analysis of My Experiments by Sollenberger that Betray His Massive Confusion

Statement 9	Appendix 1: The SL is 3 or 4 for user data. The very first packet is SL 5 but with no data payload. This packet may be used to sound the channel for quality or other startup purposes. After it is sent, the modem goes to SL 3 and finally to SL 4 for several packets. This suggests that the connected SNR is poor to moderate in quality on the level of only 0 to 10 dB. See the PACTOR-3 technical description & the packet error plots (the plot is below for convenience). It	**Mr. Sollenberger's assertions here -- for Sept 8 -- are so mixed up that it is difficult to explain where he got them.** **He appears to confuse--and conflate--data from multiple sessions and stations**, not understanding the tables of which location was used for which function on various days. Thus he gets

27 This is an example where the ability to generate one after another messages in normal email, and have them go to WINLINK, allowed the testing to proceed.

	is also possible that for short messages, that the PACTOR-3 adaptation algorithm is conservative and simply favors the lower SL's. The effect is the same however. Most of the packets are sent with very strong and robust coding. No data payload is sent with SL5 or SL6. There are only 8 packets in the entire message. And the total transmission time may only be 15 to 30 seconds, so this may not go into even a first fade at a monitoring station. **The author indicates that the signal at the monitoring station sometimes approached S9** which he showed is a fairly strong signal close to -70 dBm on his equipment **or approaching 25 to 30 dB average SNR since the noise floor approaches -100 dBm**. This suggests that the monitoring receiver may have had about a 20 to 30 dB average SNR advantage over the desired receiver in this test (or at least what SNR was required) since the mode adaptation selected a mode only requiring around 0 to 10 dB SNR, but the monitoring receiver enjoyed an SNR of 25 to 30 dB [28]	the signal levels mixed up. On Sept 8, the bus-stop station was the intended receiver. The signal data was recorded there on the same type form given Leland (see later photo) -- but Leland did not record data, and that form was not retained, so SNR for the monitoring station is not available for the session Mr. Sollenberger is making assertions about here, Appendix 1. The experimental data plainly report the signal level **for the intended station only, not for the monitoring station** for this session as S4.[29] (More explicit data for this test than the general overview statement which Sollenberger misconstrues as discussed elsewhere.) That is explained as "-83 dBm likely" on the same page of the original report. Mr. Sollenberger thus very mistakenly writes -70dBm."at the monitoring station" but *actually this is completely unknown, because for this session the monitoring station was being operated by Leland Gallup and we have no records of the signal level during this capture.* Further, we also have no records of the noise level at the monitoring station on that date, **rendering useless his assertion of -100 dBm noise floor.** [Lowest data I have on the ICOM 725 is S1= -90 on 40 meters] Mr. Sollenberger appears to be conflating my overall summaries from

28 Sollenberger, https://ecfsapi.fcc.gov/file/11170346002261/FCC letter RM-11831 WT Docket No. 16-239 Nov 16 2019 NRS.pdf, p. 18, discussion of my Apendix 1 at the bottom of his page.

29 Gibby: "1549 N5TW 14.105.8 -- good signal from N5TW, reading about S4 on my 725 but very readable."https://qsl.net/n/nf4rc//Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf , top of page 5. This is the experimental record of that Sept 8 session. Mr. Sollenberger was freely able to reveiw this data, as it was referenced in the presented data for the Sept 8 session, on page 22 of: the disclosure.

later sessions, with this particular session, which resulted in the data of Appendix 1.

Therefore his assertions of the "monitoring receiver enjoyed an SNR of 25 to 30 dB" have no basis in ANY data and are completely erroneous.

This generally renders his conclusions meaningless.

To make this even more obvious:

Mr. Sollenberger appears to miss the fact that between Appendix 1 and Appendix 2, the roles of the stations reversed. Since there was a success in *both* configurations, it is extremely difficult to maintain the claim that the monitoring station had some highly significant advantage -- since for Appendix 1, the monitor was the home station, and for Appendix 2, the deployed station. You can't have it both ways!

The best explanation I can find for all of this confusion is that Mr. Sollenberger possibly misinterpreted an overview statement made on page 18 of my disclosure of successful PACTOR monitoring, both misquoting[30] or misunderstanding the statement, and applying it to the wrong station/receiver in his detailed discussion for Appendix 1.

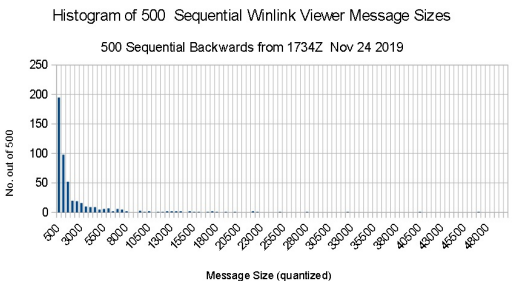
30 Changing my statement that the signal never above S9 to a claim that it "approached S9." Signals rise and fall. My photo of the Sept 8 experimental record shows I measured S4. On other days it may have been stronger. I gave an overall assessment and Mr. Sollenberger mistakenly tried to compute a steady SNR from it.

Statement 10	Appendix 2: **The situation is similar to Appendix 1.** The file is a bit longer. Almost all data is sent with SL3 and SL4. There is one case of user data payload being sent with SL5. There is no usage of SL6. Appendix 3: **The situation is similar to Appendices 1 & 2.** Most of the data is sent with SL3 & SL4. [31] [emphases added]	ROLES HAVE REVERSED (as plainly explained in the original report) Mr. Sollenberger's observations appear based only on the observed SL (signal levels) reported by PMON at the monitoring location -- which was different on different days. It appears that Mr. Sollenberger did not understand that these captures are from Sept 10 session #2 and **the roles have completely reversed** -- the intended recipient is now at my home, and the monitoring station is now at the bus-stop **(plainly indicated in the published experimental record)**
Statement 11	"There is failure for the one and only example of a longer message,..." [32]	Mr. Sollenberger believes that the message of Appendix 4 is the "one and only example of a longer message." I believe Mr. Sollenberger's distinguished career has made him very familiar with high speed cell phone communications, adjusting his calibration of what is 'long." He apparently is unaware that the message perfectly captured in Appendix 3 had over 1200 characters. Based on my published histogram of 500 sequential Winlink messages, this is likely longer than more than 55% of Winlink messages![33]
Statement 12	Appendix 4: This is the case of a longer **(but still only moderate length)** message and also one where Gibby had major difficulty in decoding the message. He never successfully decodes this	Mr. Sollenberger appears unaware that a message of 37,000 characters is at the extreme tail of the histogram of typical WINLINK messages transferred over

31 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf page 19

32 Sollenberger: https://ecfsapi.fcc.gov/file/11170346002261/FCC%20letter%20RM-11831%20WT%20Docket%20No.%2016-239%20%20Nov%2016%202019%20NRS.pdf p 18.

33 Gibby, https://ecfsapi.fcc.gov/file/1125713122662/InconvenientData.pdf , See Figure 1, p. 13

	message. He proposed RX diversity to help with this problem, but he does not actually implement it. It must be noted that this is a failure to decode a moderately longer message, even under a somewhat controlled over-the-air situation and **where the monitoring station appears to enjoy a significant SNR advantage over the desired receiving station**. Gibby suggests that there were also poorer conditions for this case at the monitoring station. But this is the stress test and the case which most directly addresses the issue of "…Winlink transmissions are nearly impossible to intercept,…" The SL starts at SL3 and SL4, and then eventually moves to SL5. On frame number 82, exactly when the sending modem switches from SL4 to SL5, the monitoring receiver misses its first packet. This is only about 10 packets into the message. All 20 user data after this was lost by the monitoring station, even though it is shown that most packets that follow are decoded successfully by the modem at the physical layer, the user data they contain is obscured by the resulting failure of adaptive decompression which follows due to sensitivity to losing a single bit or a single packet. In fact, Gibby shows that a number of errors occur after this at the monitoring station, each one would independently obscure all data following such packet losses, but the first error only about 10 packets into the exchange obscures all following data itself. This examination explains why Gibby could not decode this message. This message actually sends a number of packets using SL's up to at least SL5, but even here SL6 is never used. If the desired link had enjoyed a bit better signal quality such that SL6 was used for some packets, early failure by the monitoring station is even more likely. (emphases added)	HF. Based on my data, it would be **extraordinarily rare**.[34] (Graph reproduced here:)  Mr. Sollenberger inexplicably states that this is a "somewhat controlled over the air situation" As discussed above, this an **experiment**, and one that appears widely applicable due to the poor conditions. Mr. Sollenberger mistakenly asserts that the monitoring station appears to enjoy a significant SNR advantage. (see bolded text to the left) The experimental data clearly disprove his assertion.[35] as can be seen in the following: 1. Monitoring station missed 3 frames (and of course was unable to request a retry) 2. Intended recipient missed 5 frames (and was able to capture on retries). Both stations are capturing reasonably well, missing packets only occasionally. Those losses are likely related to episodes of deep faces which occur at different times since the stations are miles apart. **That they have very similar numbers of missed packets disproves his assertion that one station enjoys a huge advantage over**

34 Gibby: https://ecfsapi.fcc.gov/file/1125713122662/InconvenientData.pdf, see Figure 1, p. 13

35 See Section 3 of Inconvenient Truths, for a table of which stations missed which packets.

		the other. He may be drawing this mistaken conclusion from his mistaken calculations discussed above, where he conflates overview summary comments to the events causing Appendix 1. Mr. Sollenberger then surprisingly spends considerable discussion of how the monitoring station could possibly be further disadvantaged; but this is of no consequence (moot) to a committed organization utilizing diversity receiving, and choosing receivers appropriately. The point that any ONE given station attempting to monitor advanced communications can be at a disadvantage is obvious, and uncontested---I've explained that point from the very beginning and consistently explained how advanced reception techniques are required to adequately monitor advanced communications techniques. Mr. Sollenberger's distinguished career has amply demonstrated that he is *very* familiar with advanced reception techniques.[36] [37] Creating a suitable system for monitoring Winlink would be easy for this gentleman.

REPRISE OF EXPERIMENTS CONDUCTED

TABLE 4: Experiments at a Bus Stop With PMON and a Pactor Modem

36 Transmitter diversity for OFDM systems and its impact on high-rate data wireless networks; https://ieeexplore.ieee.org/document/778182

37 A simplified approach to optimum diversity combining and equalization in digital data transmission; https://www.semanticscholar.org/paper/A-simplified-approach-to-optimum-diversity-and-in-Li-Ding/c3f5638f69f98ee33559abd7fadf8580d3c1ccdf

PREVIOUSLY FILED EXPERIMENTAL METHOD AND DATA	CURRENT ELABORATION TO TRY AND ALLEVIATE THE EVIDENT MISUNDERSTANDING
The Monitor Scenario was chosen to attempt the best possible match to what any person wishing to truly test this monitor concept would wish. I wanted to find out if this would work. Although I tried several different iterations, the following was the most successful automated method and illustrates the protections taken to insure it was a useful test: 1. All email transfers were initiated FROM N5TW approximately 912 miles from the monitor location and the intended recipient (KX4Z). 2. The Monitor Station was not in any way involved in the transfer. (Not "connected.") 3. The Monitor Station didn't have any knowledge or information as to the callsigns of either station involved in the transfer connection; it simply was on frequency and running PMON HEX 1, PMON VERBOSE 3, PMON START. 4. At the beginning, I had no preconceived idea of which remote gateway would be monitored at the beginning. It turned out that N5TW was one of the ONLY stations I could even HEAR at the time points I was able to do my testing, so that because my standard. N5TW would generally have a reasonably strong signal on 20 meters, but never above S9. There was considerable QSB (fading) on some efforts. On the transfers that actually were captured, I didn't even know precisely when it would occur --- just roughly 15 minutes from the previous one, because I had set the gateway to check for CMS traffic approximately every 15 minutes. It actually ended up being rather variable, and I don't know why since I wasn't able to monitor it Thus, I was truly a monitor station, just sitting on a frequency and hoping for traffic. 5. ***It is important to recognize that the transmitting station being monitored was NOT the 9-mile KX4Z, but was instead the 912 mile N5TW.*** (In various experimental sessions, I reversed which station did what but always the transmission being monitored came from the station several states away.)	*The model here is of a monitoring station listening to a station somewhere in their own state, who is receiving an email message from a sending station several states away. I can't think of any better way to create a realistic model. There is no point to putting your monitoring station in Egypt, for example, if you wish to monitor United States transmissions. On the pilot trial day, Sept 8, I tried 40 meters and just coudn't get any connections at that time of day, so I moved to 20 meters. Although N5TW was "yellow" in the propagation predictions, he has good antennas so I gave him a try and happily I got a reasonable signal out of him. I then used him for this and subsequent work. As the record shows, at times there was complete fade to zero. Other times the signal was more constant. I had no way at all to control either N5TW or KX4Z home station -- I was nine miles away from one, and 900+ miles from the other, at a bus-stop.* *There was a lot of fading..... [Statement 2: zero-fading or highly favorable/unusual propagation conditions (e.g. near perfect channel conditions)--is obviously completely false.]* *I have previously published information about the S-meter on these type radios. The record plainly records "There was considerable QSB (fading)...."* *I was always capturing*

Illustration of the signal paths (RED). There were never any communications between Monitor and Connected station. The task pursued by each location were variable by day of experiment. This drawing's legends pertain to the Sept 10 experiments. The only connected stations were N5TW and KX4Z involved in radio transfer; the monitor never had any advance knowledge of anything except the frequency. All emails monitored were transmitted from N5TW, approximately 912 miles distant.

Most experienced users of WINLINK in my area know that it is much easier to make a connection after dark. The possible number of "green" stations in the WINLINK Propagation tool vastly expands at nighttime. This is likely do to the waning D-layer after the sun goes down.

As it turned out, I was unable to carry out nighttime tests at the bus stop ParkNRide. The problem was excessive frying-pan noise.. There was a sodium vapor lamp-post just 10 yards from my antenna and monitoring location, and I suspect this was the culprit. I couldn't hear anything. So I had to be satisfied with DAYTIME (in my estimation, more difficult) tests.

transmissions from N5TW 900 miles away, no matter which location was "intended" or "monitoring." How much more realistic can you get? [Statement 1 is mistaken]

I was performing these experiments in the afternoon -- the hardest time of the day generally to make a Winlink connection right now during the sunspot minimum. (Nighttime is generally much more productive.) I'm not a DXer and I really don't have a ton of experience on 20 meters. It was just the only place I could make a connection. [Statement 1 is mistaken.]

My "control" over the receiving site was quite limited. I couldn't do ANYTHING about that sodium vapor lamp that made nighttime reception impossible. Once it came on, I was unable to hear anything. [Statement 1 is mistaken.]

The situation was far from optimal. I eventually discovered the truck had bad ignition noise so I had to shut it off and WOW! does it get HOT in a pickup truck in Florida. See that palm tree? My dog leash

Awkward but usable Monitoring Station.

Because this was 20 meters and I was approximately 9 miles from the "initiating station", I could generally hear the WINLINK pactor calls initiated from KX4Z gateway station, running RMS_RELAY (the standard gateway software). They were NOT strong. Getting those calls to occur took some effort. For one or two sessions, I was able to set the home station to do automated "CMS Checks" and search for email to be delivered to me. For another session, I made some mistake and that didn't work, so an Extra Class neighbor drove over and manually commanded WINLINK EXPRESS to call stations for me. That effort was the unsuccessful evening effort when I simply couldn't hear anything for the RFI.

Monitoring Station Location. Wire vertical came down in the palm tree. Blue box visible at the bottom of the palm is the 1:49 end-fed Balun in a Carlon electrical handy box.

Connect attempts begin with a "ROBUST CALL"

```
###CONNECT: [Robust Call: N5TW]
þú

###CONNECT: [Robust Call: N5TW]
þú

###CONNECT: [Robust Call: N5TW]
þú
```

and then proceeds through the standard B2F protocol:

screw was screwed into the ground there for my "ground". I used a slingshot to put the wire over an oak tree out of this picture to the left. This is about as far away from a prize-winning "contest station" that you can get.....and I still copied WINLINK messages from several states away without much trouble. [Statement 1 is mistaken]

That's my homemade plywood go-box there with the older radio in it. The older Lenovo computer is perched on a console the previous owner of the truck had installed. You can see my clipboard in the photo and my ever-present Diet Pepsi. It is a difficult receiving situation ergonomically. [Statement 1]

[Statement 6 is completely disproven.]

One session was completely fruitless until a neighborhood ham went over and manually got my home station to do some calling Without that, the experiment wouldn't even be possible at that session.

These tables are included to help

FC EM O0HVWTJJHS1W 588 432 0	Proposal to transfer, using Protocol C, an Encapsulated Message with the given ID#, uncompressed size 588 (decimal) and compressed size 432.
F> 4B	Various bits of handshaking that I don't fully understand and were not germane to me monitoring the emails.
65,73,74,**00,30,00**,02,FA,6F,E7,4C, 02,00,00,EC,F5,7A,1C,6D,67,6F,79, D4,F1,78,FC,1D,6B	..00,30,00 --- (hexadecimal) -- indicator of beginning of the compressed message. 02- start of first logical packet FA - hexadecimal (250 decimal) -- there are 250 bytes of material following in this logical packet
....02	02 -- start of next logical packet (next 2 characters gives size of that logical packet)
04 (after end of logical packet)	End of message packets.

Capturing the Received Text to Disk

Now that I had a Windows version available from Hans-Peter Helfert or could move text from one computer to another, I used my Windows laptop for capture. I utilized a freeware program, COOLTERM on a laptop windows computer to capture the traffic to disk (at that time, Hans-Peter Helfert had not yet finished his amazingly improved software). I then could take the disk file and analyze it with either the raspberry or the windows software and see what I had captured.

RESULTS

RECORD OF EXPERIMENTAL SESSIONS (SYNOPSIS)

DATE	Attempt		Result
Sept 8	**Location**	**Assignment**	A very frustrating beginning. I was not able to make ANY working contact that allowed the home
	ParkNRide,	Live initiator	

readers who have zero experience with WINLINK to understand how t works. It is very much like packet calls of 30 years ago.

This is the record of the first attempt-- 40 meters just wouldn't work. I was being the intended station this time, with the home station being the monitor. Couldn't make 40 meters work at all,

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>Newberry</td><td>of email downloads</td></tr>
<tr><td>Home Station, Jonesville</td><td>Supervised monitoring (capturing packets)</td></tr>
</table>

First attempt at monitoring distant emails. On this day, I was trying to initiate email transfers by calling distant RMS's from the Newberry ParkNRide location, and having Leland AA3YB manage frequencies and free-running computer capture of modems in Jonesville

The full blow-by-blow of this initial pilot session can be viewed here (this is a synopsis): https://qsl.net/n/nf4rc//Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf
</td>
<td>stations to capture any significant number of packets -- just not enough signal on 40 meters.

We switched to 20 meters, tried N5TW and a SUCCESS. See Appendix 1 for the email perfectly captured. My notes suggest that I tried other emails but never fully analyzed them after that success.

TRUCK: It may have helped that the truck overheated and had to be shut off. I discovered on a later day's testing that there was enormous ignition noise from the truck. I don't know why I didn't comment or notice this in the record of Sept 8th testing. Perhaps the ignition system is variable?

Conclusion from the first day: SIGNAL LEVEL is the key. If you cannot get enough signal for the pactor to read it, nothing will work.

This hour's work suggested that the Jonesville station had inferior signal situation to the ParkNRide--when the truck was shut off!!!</td>
<td>switched to 20 meters. [Statement 1]

The truck overheated at some point. I didn't realize it at that time, but it may have been making ignition noise. This is anything but an optimal situation. [Statement 1 is mistaken.] [Statement 6 is completely disproven]

This was the first time I had tried this and my conclusion was that the pactor modem had to have SOME SIGNAL. My comments indicate that I thought the bus stop sling-shot end fed vertical is working better to N5TW than the home station inverted V at 50 feet. That signal advantage, although slight, may have been what was needed! Pure luck.</td>
</tr>
<tr>
<td>Tue Sept 10

(1st trial)</td>
<td>
<table>
<tr><th>Location</th><th>Assignment</th></tr>
<tr><td>ParkNRide, Newberry</td><td>Live Monitor</td></tr>
<tr><td>Home Station, Jonesville</td><td>Receiving station of potential radio-only emails imitated by N5TW</td></tr>
</table>

90 minute monitoring attempt hoping to get N5TW to send Radio Only email for NF4RC to gateway KX4Z
</td>
<td>The system to have emails sent never worked. There were just no pactor messages calls ever made.</td>
<td>The September 10 1st try experiment failed due to some error on my part. [Statement 1 is mistaken]</td>
</tr>
<tr>
<td>Tue Sept 10

(2nd trial)</td>
<td>
<table>
<tr><th>Location</th><th>Assignment</th></tr>
<tr><td>ParkNRide, Newberry</td><td>Live monitor</td></tr>
<tr><td>Home Station, Jonesville</td><td>Automated CMS checking to instigate email downloads</td></tr>
</table>
</td>
<td>1. Perfect capture on first email. (See Appendix 2)
2. Near-perfect capture on 2nd email (See Appendix 3)
3. Washington's Farewell address (37kbyte uncompressed) made it only a small distance before a packet was lost (See Appendix 4) Severe fade in signal strength</td>
<td>I went back later on the same day and was able to get the home station to do automated CMS checking ONLY from N5TW -- giving me transfers to monitor (hooray!!) -- the record indicates perfect capture on the first one, near perfect on the</td>
</tr>
</table>

<table>
<tr><td></td><td><table><tr><td></td><td>from N5TW</td></tr></table>
Switched to automated q15 minute CMS checks by KX4Z -- worked! N5TW responded each time and initiated an email

<u>Packet Capture</u>
Note that I intentionally activated PMON PACKETS 1 -- which allows PMON to present the repeater Packets (RQ::1 also). This information allowed the discussion within the Diversity Receiver Section</td><td>perhaps every 2 minutes to un-noticeable signal on the S-meter -- during that episode the PACTOR lost the signal. (But see later discussion in the Diversity Receiver Section) . (Representative ICOM S-meter calibration in Appendix 6)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Sept 12</td><td><table><tr><th>Location</th><th>Assignment</th></tr><tr><td>ParkNRide, Newberry</td><td>Live monitor</td></tr><tr><td>Home Station, Jonesville</td><td>Live WINLINK EXPRESS contacting gateway to download messages.</td></tr></table>
Nighttime attempt 8 PM on 40 meters</td><td>Unable to catch more than a smattering of packets through the frying pan RFI noise. Unable to receive signal. The sodium vapor streetlamp in the ParkNRide 10 yards away from my antenna is the likely reason Trip was a bust.</td></tr>
</table>

Conclusion: In general, if I could HEAR the packets and see something on the S-meter, my monitor station could read at least a portion of the email, and more often than not, the entire email. These are only limited experiments, but far more successful than I expected! The PACTOR modem is truly amazing to watch. Only when the S-meter went completely to ZERO in severe fading, and I couldn't hear the signal, did I lose packets. It was really amazing.

Even more so, when the results of the next Section, on diversity receiving preliminary data, are reviewed.

Because of the sodium vapor lamp I was never able to do any monitoring in the evening, but the results above were so outstanding that I concluded it was of lesser importance to continue the monitoring sessions. The completion of Hans-Peter

2nd, and then the most valuable effort in terms of evaluating the advantages of diversity was the attempt at the 37kb Washington Farewell address.... SEVERE FADE every 2 minutes to no visible signal -- both the home station and the monitor station were apparently experiencing the same thing. This completely debunks any belief that I had great receiving conditions that I had control over!
[Statement 1 is mistaken]
[Statement 2: zero-fading or highly favorable/unusual propagation conditions (e.g. near perfect channel conditions) is clearly completely mistaken.]
[Statement 3 -- WRONG! Here is experimental proof that it can be done. How come something that is impossible be done repeatedly?]
[Statement 6 is completely disproven.]
[Statement 8] -- completely mistaken as shown in the prior Figure comparing my available test messages to the experimental record. You just have to see what an SCS modem can do, to believe it.

Here is my record of the nighttime failed attempt due presumably to the noise from the sodium vapor lamp.
[Statement 1 is mistaken]

My experimental conclusion was that if there was an audible signal and some signal on the S-meter, it worked. My comments indicated it was more successful than I had expected. And that the pactor modem was amazing to me. Obviously I'm just the observer here, I have very little control of anything.

Helfert's on-the-fly decoding system convinced me that this was now a free commercial product, a working system, and little additional proof was needed from me. Users could then provide post-marketing feedback to a real vendor to see any future improvements.

Carrying out this analysis for packets known-missed in the long transmission of the George Washington farewell address yields the following information:

ANALYSIS OF MISSED FRAME BY RECEIVING LOCATION, GEORGE WASHINGTON FAREWELL ADDRESS

Frame Number (FRNR) reference (monitoring capture)	**Intended Recipient**	**Monitoring Station**	**Comment**
76	Captured	Captured	Beginning of data
77-81	Captured	Captured	Total of 6 frames captured by monitoring station
	No indication that the intended recipient missed this frame	Missing FRCTL 3 because the counter went from 2 directly to 0	Intended recipient got the frame missed by the monitoring station
82,83	required a RESEND	captured both transmissions	Monitoring station caught the original frame that the intended recipient missed on 1st try--and then got the resent also.
84,85	required a RESEND	captured both transmissions	Monitoring station caught the original frame that the intended recipient missed on the 1st try.--and then got the resent also.
86,87	required a RESEND	captured both transmissions	Monitoring station caught the original frame that the intended recipient missed on the 1st try--and then got the resent also.
88,89	required a RESEND	captured both transmissions	Monitoring station caught the original frame that the intended recipient missed on the 1st try--and then got the resent also.
90, 91	captured	captured	
	apparently captured	Missed frame -- FRCNT 2 is missing	No indication that the intended recipient missed this frame
92-95	captured	captured	
	apparently captured	Missed frame -- FRCNT 3 is missing	No indication that the intended recipient missed this frame.

This is the original published analysis of which frames were missed by which station, in the George Washington Farewell Address test.

[Statement 4: These data prove the assertions in Statement 4 are completely mistaken. You merely need to be able to use some diversity to get around the problems. These data show that one of the longest winlink messages ever typically transmitted could be received with 2 diversity stations....so much for the claims of Statement 4]

[Statement 5: completely disproven here. Two stations with fairly similar success suggest not much disparity in signal fading; not at all perfect signal path, and a diversity system would have succeeded completely at a HUGE message, at least for HF ham radio.]

This allows a rough estimate of the fading and the signal advantage of each station.

My monitoring station in the passenger seat of the pickup misses 3 frames.
[Statement 2: zero-fading or highly favorable/unusual propagation conditions (e.g. near perfect channel conditions) is obviously false.-- and my diversity solution appears to be the answer.]

96-99	captured	captured	
100, 101	required a RESEND END OF FILE	captured both transmissions END OF FILE	Monitoring station caught the original frame that the intended recipient missed on the 1st try-- and then got the resent also.
END OF 36,000 CHARACTER GEORGE WASHINGTON FAREWELL ADDRESS			

The quite surprising conclusion drawn from these data, is that **if one had access simply to the frames captured by both these two receivers, 9 miles apart, one would have been quite likely to reconstruct the entire 36,000 character George Washington farewell address.** Apparently because they were separated in space by 9 miles, the fading (severe QSB) was temporally disparate at these two stations -- so when one station's reception faded to zero, the other station still had a capture; and then the reverse happened. You can see this cycle repeat throughout the multiple packets of this transmission.

You can also see the modems switch from short packets to long packets (3.75 seconds) and also the speed level changes that were taking place and were being accommodated by the monitor station and the intended recipient, precisely as Hans-Peter Helfert had explained.

This is my first and obviously fascinating evidence that the diversity receiver system would work, and is worthy of further rigorous evaluation.

The intended recipient misses 5 frames ((by noticing when it demands retries.

It appears that BOTH stations were experiencing significant FADING, but at different times. (This is the advantage of spatial diversity)

[Statement 2: zero-fading or highly favorable/unusual propagation conditions (e.g. near perfect channel conditions) -- clearly wrong-- I'm capturing frames all the way down the fade until the signal is just GONE.]

The monitoring station misses slightly fewer frames than the intended recipient -- so it has a somewhat better signal. But it is ludicrous to claim that it has a great signal! Furthermore the experiment proved that diversity receiving could be used to great advantage -- this entire, enormous message could have apparently been captured by only 2 monitors.

Table 5
EXPERIMENT RESULTS FROM NOV. 15 2019 MONITORING USING ONLY A RASPBERRY PI WITH AN ESTIMATED 3DB HANDICAP APPLIED TO THE PARALLEL PACTOR MODEM

Experimental Record

The following are the records of that original experimental research. The actual messages (or partial messages as the case may be) are produced in the Appendix.

Date of experiment	November 15 2019
Transceiver	Icom 718
Antenna	Non resonant inverted vee, window feed line, 4:1 Balun, LDG AT600 tuner, 1:1 Balun (homemade)
PACTOR	SCS PTC-II upgraded to P3
Raspberry Pi	Pi 4, 4 Gbyte Ram
Monitoring Software	SCS free software PMON 1.0-2
White Noise Source	Baofeng UV-5R squelch set to 0, radio tuned to unused channel
Amateur Band	40 meters & 80 meters (amateur bands)
Oscilloscope	Siglent, using 10:1 probe
Background noise (not tuned to any station)	Approximately 488 mV peak-peak
White Noise measured at connection to PACTOR input	Approximately 700 mV peak to peak at conclusion of experiment, suggests approximately 3.3 dB noise penalty

Table 6: Experimental Setup

Photo of the Raspberry Pi 4 and simple LCD monitor (Ebay).

RESULT
1:----------

Received by Raspberry Pi on 80 meters:

Frequency	Gateway	Distance (miles)
3.588 MHz	WD4SEN	53

```
Date: 2019/11/15 17:34
From: K4WK
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
```

Perfect Reception! How can this be impossible?
[Statement1: proven false]

[Statement 7: completely mistaken -- only a very small advantage here and a Raspberry pi works!]

To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Subject: //WL2K pls send me your conventional email addresses
Mbo: K4WK
Body: 104

Both my Red Cross and my comcast email clients are hiccuping on the winlink,org email addresses. Tnx

(Perfect reception)

RESULT
2:----------

Another message on 80 meters

Frequency	Gateway	Distance
3.588 MHz	WD4SEN	53

MID: 7FRN861K2C0L
Date: 2019/11/15 19:13
From: KG4ARC
To: SMTP:cwa01@comcast.net
To: SMTP:bob.lirtzman@redcross.org
To: SMTP:michael.hoeft@redcross.org
To: SMTP:carl.piojda@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Subject: //WL2K Echolink try out
Mbo: KG4ARC
Body: 101

If you are available this afternoon, let's have a quick meetup on Echolink node N4SBD-R at 3pm EST.

(perfect reception)

RESULT
3:----------

INCOMPLETE
missed the last portion of this message

Frequency	Gateway	Distance
3.588 MHz	WD4SEN	53

MID: OXQB0DNPOVIM
Date: 2019/11/15 17:42
From: K4WK
To: SMTP:carl.piojda@redcross.org

Perfect reception. Remember, these are REAL MESSAGES from others involved in a Red Cross simulated Exercise in Atlanta. [Statement 1 proven false with a modest advantage given to the Raspberry pi] [Statement 7 demonstrated false with only about 3 dB advantage.....]

To: SMTP:cwa01@comcast.net
To: SMTP:michael.hoeft@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
To: SMTP:bob.lirtzman@redcross.org
Subject: //WL2K Pictures!
Mbo: K4WK
Body: 359

Please take some good photos of your operations this Saturday for me for future PR. Here's a list:

picture of self at your r

INCOMPLETE RECEPTION

RESULT 4:----------

I turned the noise up a bit (to the 3.3 dB measured at the end); went to 40 meters. Got this entire message flawlessly at 600 bps [number demonstrated on WINLINK EXPRESS software]

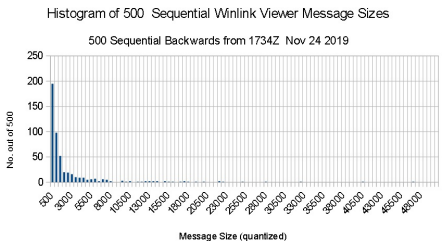
Frequency	Gateway	Distance
7.1037	AJ4FW	534

MID: 8GVI94IQ4S0Z
Date: 2019/11/15 20:36
From: KG4ARC
To: SMTP:cwa01@comcast.net
To: SMTP:carl.piojda@redcross.org
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Subject: Re://WL2K Echolink try out
Mbo: KG4ARC
Body: 721

One station came on at 3pm. Guess it wasn't a good time for most of us.

Pls let me know any other time today or this evening you like to try this. Doesn't matter where you are; the node is in Atlanta but the other station who came on is in New York.

Result 4.
Perfect Reception of a message that by WINLINK standards, is fairly long at 721 bytes. Here for comparison is the histogram of Winlink messages that I recently computed.[38]



[Statement 1 proven false with a very small advantage given to the Raspberry pi]
[Statement 4 is totally, completely mistaken....here is a REAL MESSAGE that includes multiple previous replied-to messages...and it gets captured completely with only a modest receiving advantage for a raspberry pi! And this is without any diversity at all]

38 Gibby: https://ecfsapi.fcc.gov/file/1125713122662/InconvenientData.pdf, see Figure 1, p. 13. The 721 byte message is longer than at least 40% of the 500 messages in that random sample set.

Frequency	Gateway	Distance
3.5925 MHz	WW4MSK	377

```
MID: PZ38FRVVFAA7
Date: 2019/11/15 17:30
From: K4WK
To: KX4Z
To: W4AKH
To: SMTP:jeffcapehart@gmail.com
To: W4UC
To: KF4DVF
To: KV4LY
To: SMTP:roywfgs@cox.net
To: K4HBN
Cc: K4WK
Subject: //WL2K test msg of tiny k2s form
Mbo: K4WK
Body: 211
File: 1007 Mickey_Mouse_seeking_Minnie_-_K4WK-
20191112-175235L-4.k2s

Open the msg, save the attachment to your
NBEMS.files\ICS\messages folder, then you can open
with flmsg.

Sorry this is so complicated; I didn't make it up but
I am powerless to make it simpler.

Rgds, Wayne
<flmsg>4.0.11
:hdr_ed:20
K4WK 20191211225253
<customform>
:mg:892
CUSTOM_FORM,ARC_Emergency_Welfare_Inquiry_Form_v_1.0.
html
DRONum,9999-99
ARCVolName,Robertson
ARCVolCity,Decatur
ARCVolState,Georgia
ARCVolZip,30030
ARCName,Mouse
ARCName,Mouse
ARCInitial,
ContactAddress,1313 Disneyland Drive
ContactCity,Anaheim
ContactState,CA
ContactZip,12345
Contactcountry,United States
87,14,BB,13,62,54,BE,AE,63,F0,1A,24,42,14,5B,ED,67,A4
,0E,E3,3F,14,5A,39,4A,46,31,6E,9C,E0,38,7C
3D,9F,F9,3B,80,D7,E8,58,9C,D2,CE,3F,D7,CF,1E,AF,CC,7D
,23,EC,2E,1B,FE,F8,99,BF,78,E4,9D,11,F4,6A,CF,20,66
84,B0,4C,B4,5D,F0,C7,23,7B,FA,EA,0A,13,99,8C,D7,4F,81
,06,CC,8D,48,81,D1,63,50,22,A8,C2,F0,9E,9E,82,56,0B,6
C
9D,9D,A7,F6,1E,F9,A0,EA,E7,43,06,93,43,B5,66,00,19,5E
,C6,6D,10,14,B0,98,6D,59,93,59,B2,4C,68,69,9B
A5,F5,4F,7E,CD,80,77,29,6A,25,BE,C6,6B,94,F9,A0,93,94
,40,7C,E3,36,BA,A5,9A,A1,10,E0,12,84,D4,EE,A0,89,6D
4E,68,C0,BC,16,75,1E,81,D7,F2,B3,CC,3B,BC,3F,A5,91,6F
```

[Statement 3 is shown to be mistaken -- here you get a lot of the message despite an extremely poor message channel!]

[Statement 5 --this example shows that statement is incorrect. What matters is the signal to noise ratio and the number of stations involved if diversity is employed, (here I have only 1) -- and this is CLEARLY POSSIBLE and could probably be done even using web accessible SDR receivers by the general public.]

```
,07,8E,B1,02,B1,01,2E,BE,C1,34,4D,4C,BE,88,4C
0F,CD,90,A7,DE,F8,A6,16,84,17,85,2F,58,39,91,4B,7C,CC
,01,16,A5,B9,86,94,06,D6,0A,7D,A8,BA,7F,CE,9D
F4,8D,8D,DD,89,8E,CA,2F,BB,40,43,A4,A2,B0,E8,15,AA,10
,7A,6E,76,91,B3,FA,FA,00,83,92,05,D3,64,D4,3E,E7
21,0B,F2,86,F6,B8,0D,0A,DF,96,9B,E7,F1,9D,FC,4C,4C,05
,46,39,B3,4E,0F,E3,5F,CD,F4,F4,74,F8,53,ED,83,3E,FE,0
3
C0,05,AA,21,8D,A7,A1,AF,17,48,10,00,B2,37,D0,D1,37,22
,43,49,FF,4A,D4,9D,94,A2,2F,F0,03,04,00,04,CA
EM 7U
```

Captured message, did not capture the attachment.

RESULT 6:

Raspberry Pi PMON missed one message completely Unclear why (likely missed the required characters to initiate the capture apparently)

RESULT 7: ----------The surprising one----------

This is the most surprising experiment result, and example of the Raspberry Pi capturing a portion of the message (and immediately delivering it due to the advancement of the LZHUF routine by Peter Helfert) --- but the intended recipient (the Pactor modem and WINLINK software) reached the maximum number of retries and aborted -- which means nothing was provided to view, at all.

Notes created at time of experiment:
40 meters to kb5lzk. signal is dropping out. pmon got a bunch and then lost it. The pactor is struggling.-- and eventually QUIT -- so the intended recipient computer NEVER got to read the message. Meanwhile, the monitor gets to read a good portion!

Frequency	Gateway	Distance (miles)
7.1016 MHz	KB5LZK	669

```
PACTOR-1/2/3 Monitor started:
=============================

utes remaining with KB5LZK
{SFI = 070 On 2019-11-15 23:00 UTC}

Welcome to KB5LZK at the Ar Division of
EmerM$]
;PQ: 23700977
CMS via KB5LZK >
: KX4Z ROLRRFM1SU3R 3505
wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross
```

Result 6.
I'm presenting ALL the results -- so here you see my record of a message that was completely missed.

Result 7.
And here is perhaps the most important example -- a case where the monitor actually gets to read part of a message -- but the intended recipient gets NOTHING. *This completely turns the situation around and illustrates just how mistaken the understanding of the experimental conditions are results are by some of the commenters.*
[Statement 1-- completely mistaken.... how do you deal with this outcome?]

ARES Radio
;PM: KX4Z D4NFDDU80NY0 3523
wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross
ARES Radio
;PM: KX4Z 7U9N9396PDZR 3718
wayne.robertson@redcross.org Re: [EXTERNAL]
Re: //WL2K FL WL Participation in Red Cross
ARES Radio
;PM: KX4Z 5GP3GTT8YDC7 3803
jeffcapehart@gmail.com Re: [EXTERNAL] Re:
//WL2K FL WL Participation in Red Cross ARES
Radio
FC EM ROLRRFM1SU3R 6563 3505 0
FC EM D4NFMID: ROLRRFM1SU3R
Date: 2019/11/15 19:33
From: SMTP:wayne.robertson@redcross.org
To: KX4Z
To: W4AKH
Subject: Re: [EXTERNAL] Re: //WL2K FL WL
Participation in Red Cross ARES Radio
Mbo: SMTP
Body: 6353

Let's try Echolink today at 3pm Eastern time;
N4SBD-R.

_____
From: KX4Z@winlink.org <KX4Z@winlink.org>
Sent: Friday, November 15, 2019 7:26 AM
To: W4AKH@winlink.org <W4AKH@winlink.org>;
Robertson, Wayne
<wayne.robertson@redcross.org>
Cc: jeffcapehart@gmail.com
<jeffcapehart@gmail.com>
Subject: [EXTERNAL] Re: //WL2K FL WL
Participation in Red Cross ARES Radio Drill
Nov 16

Thank you for the information below.
However, I am unable to

a___
- Sn !
cyRm_s
_5RbtW_Ca9
1_ iKH@winlink.orgo__:a_w.l
ahima_T aNF_unaa
c<R1BD,6E,F0,E2,F4,EB,2E,2F,63,88,65,EF,B8,0B,
D3,6D,0F,4C,81,68,9B,FF,E9,CE,02,B2,5C,49,57,C
9,E3,8E,61,40,78
^Cpi@raspberrypi:~ $

CONCLUSIONS

1. I appear to be one of only perhaps ***three*** persons who is actually testing over-the-air reception of WINLINK PACTOR.

2. It has become rather perfunctory to me. Even monitoring with a Raspberry Pi (given a few dB advantage).

3. Mr. Sollenberger's conclusions[39] related to my experiments are completely meaningless because of the serious nature of his misunderstandings of the actual experimental effort, driven (in part) by confusion of which station is being used for which purpose, and which signal level is bring reported.

4. The conditions under which I tested the simulated "secret agent" surreptitious monitoring were, if anything, grueling and severe -- they represent a worst-case of attempting to monitor WINLINK....and they succeeded! This makes it rather obvious that any reasonable station in a group of committed monotirs could be part of a very successful diversity monitoring system.

5. With any reasonable signal that you can see on an S meter, when I was the monitor station, I was generally able to monitor dynamically compressed WINLINK pactor signals using a PACTOR DRAGON modem.

6. The degree of success was quite surprising to me in the experimental record! The major difficulties encountered were simply getting messages to be available for monitoring, the ignition noise of my truck, and the oppressive heat when I had to turn off the truck, and the ergonomics of the truck. It is stunning to watch the monitor station computer start to spit out the surveiled WINLINK message in near-real-time, while the intended recipient has NOTHING yet to read -- and in one example, never got anything to read!

7. The signal conditions included fading to nothingness and were certainly representative of the range of conditions, from acceptable to horrible.

---

39 Sollenberger: "An examination of the interactions of HF channel fading characteristics, adaptive modulation and coding, ARQ, and adaptive compression, found that only under conditions of extreme signal SNR advantage or equivalent conditions would a monitoring 3rd party be able to fully or mostly decode Winlink over PACTOR, WINMOR, ARDOP or VARA messages for messages of significant length. This provides substantial support for the claims that: "…Winlink transmissions are nearly impossible to intercept,…" (see reference 1) There are reasonable and documented methods that the relevant parties could engage to address this issue and support independent per packet decoding by 3rd parties or similar characteristics to address the issue that the loss of a single modem packet renders all following user data 100% obscured (see pages 13 & 14) Experiments by Gordon L. Gibby were analyzed in detail as well as analysis of experiments by John Huggins. The results agree clearly with the previous paragraph. Gibby was unable to decode moderately long messages even with controlled over-the-air conditions on 20 meters. He was able to decode several short messages under 3 joint conditions: 1) robust coding for the data by the transmitter possibly due to poor/moderate SNR at the desired receiver; 2) a strong clean signal at the monitoring station; and 3) fairly short messages with a few lines of text. "

8. The amazing success predicted for a simple diversity system on the single try at George Washington's Farewell Address demonstrates that this is easily possible, given any degree of technical sophistication and commitment.

9. My experiments with the Raspberry Pi suggest that its handicap is only a few dB compared to the much more capable and expensive Pactor modem.

10. The most stunning piece of information in the FCC record is that apparently no one else cares enough about monitoring WINLINK over the air to even try it and comment.

APPENDIX: CAPTUREPRACTICE DOCUMENT FROM SEPTEMBER 8 2019

Apparently I have mislaid the original .odt file of this experimental record, and what I still have is the pdf which has been available (and was noted in the published FCC filing) at:
https://qsl.net/n/nf4rc//Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf
in a much better formatted display.

However, since there seems to be such confusion about the experimental record, I did a "select all" "copy" "paste" from the available PDF to capture as much as possible of that into this filing to allow some annotation, to address some of the confusion that seems rife.

---https://qsl.net/n/nf4rc//Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf---

REPORT ON CAPTURE PRACTICE -- DAY ONE

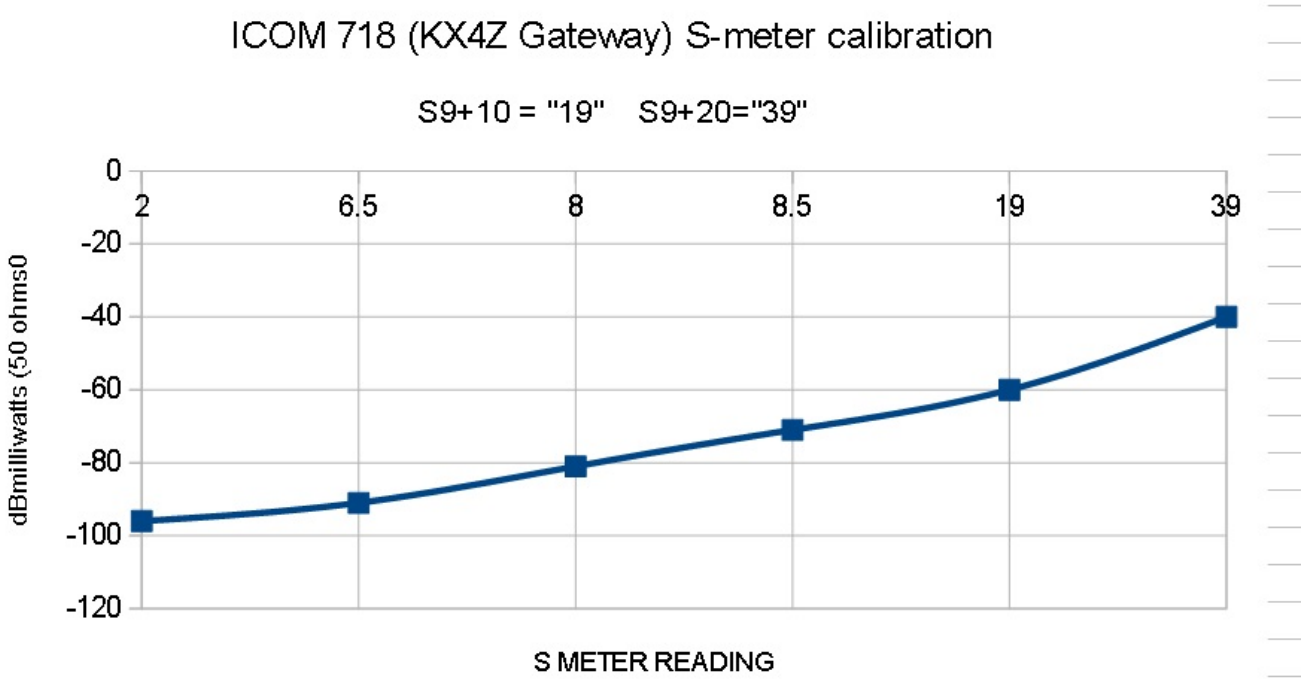
Day of Practice: Sept 8 2018
Gordon L. Gibby --- Newberry ParkNRide
Leland Gallup -- 15216 NW 41st Ave, 2nd floor
Two monitoring stations, denoted
"Radio Room" (receiver IC-718 & 7800 modem, sloping non resonant dipole from 12 feet to 30 feet, normally used for NCS521); and
"Gateway Room" (receiver IC-718 and loaned 7400 modem, inverted V non resonant antenna approx 50 feet up, normally used for KX4Z gateway)
Goal: get the "lay of the land" of capture from distant stations.

And just to be VERY clear: this testing strategy was set up to mimic as closely as I could, what Ron Kolarik or anyone else would want the test to look like:
1. The monitor station (my house) is hundreds to a thousand miles or so from the station [a gateway] from which traffic will be monitored. THAT IS THE KEY POINT.
2. To avoid damaging things or throwing modems out of kilter, I set myself as the "initiator" of downloading emails, about 15 miles away so that my signal wasn't overloading my monitor station. But again, I'm NOT monitoring my own signal --- I'm capturing emails being provided by a DISTANT RMS, hundreds to thousands of miles away, and with fairly new software written by a very novice programmer (me) The reason I'm initiating is I do not have weeks and months to get this done --- we need to optimize this system and get answers QUICKLY as to how well, or whether or not it even works on real signals. .

1
MONITOR TEST LOCATION: My house has two available wire antennas for HF work that are usable right now. The inferior one slopes from about 12 feet to about 30 feet, keeps getting trapped under the fronds of a palm tree. The superior one is far higher, inverted vee about 45-50 feet up Both are non-resonant, and that is a problem, because both are fed by LDG-AT600 auto tuners, and in this work today, it was not really possible to TUNE them adequately. Both receivers are used ICOM 718's and one has a Dragon 7800 and the (better antenna) one temporarily has a loaner Dragon 7400. Both have raspberry pi's with identical software.
The goal was to have Leland try and set frequencies on the radios and make some qualitative analysis

of what the S meters show. The Icom 718 S meter is astonishingly non linear. I noted when we started, with both rigs on 40 meters, the infeirior antenna rig was showing S nothing, and the superior one shoring S7 --- but my experience s that there may only be 6dB difference between those two readings. We have a NOISE PROBLEM **on lower bands** at my house, likely somewhat due to my 8 kilowatts of SOLAR PANELS driving Outback Charge Controllers and 8 kW AC inverters running all the time. This was a FULL SUN day. Additionally, my house has a TON of electronics and so do my neighbors. The noise levels are nearly as nice here as they used to be as people have built out around me. This is what I have to work with, so I do the best I can. Recently my noise levels climbed even more -- it was a little wallwart that came with a remote TV headset that Nancy purchased.....roughly 10 dB more noise.

S



NOISE LEVELS AT THIS STATION TYPICALLY S7-S7-1/2 40 meters --- **implies approximately -85 dBm signal floor.**[40]

2

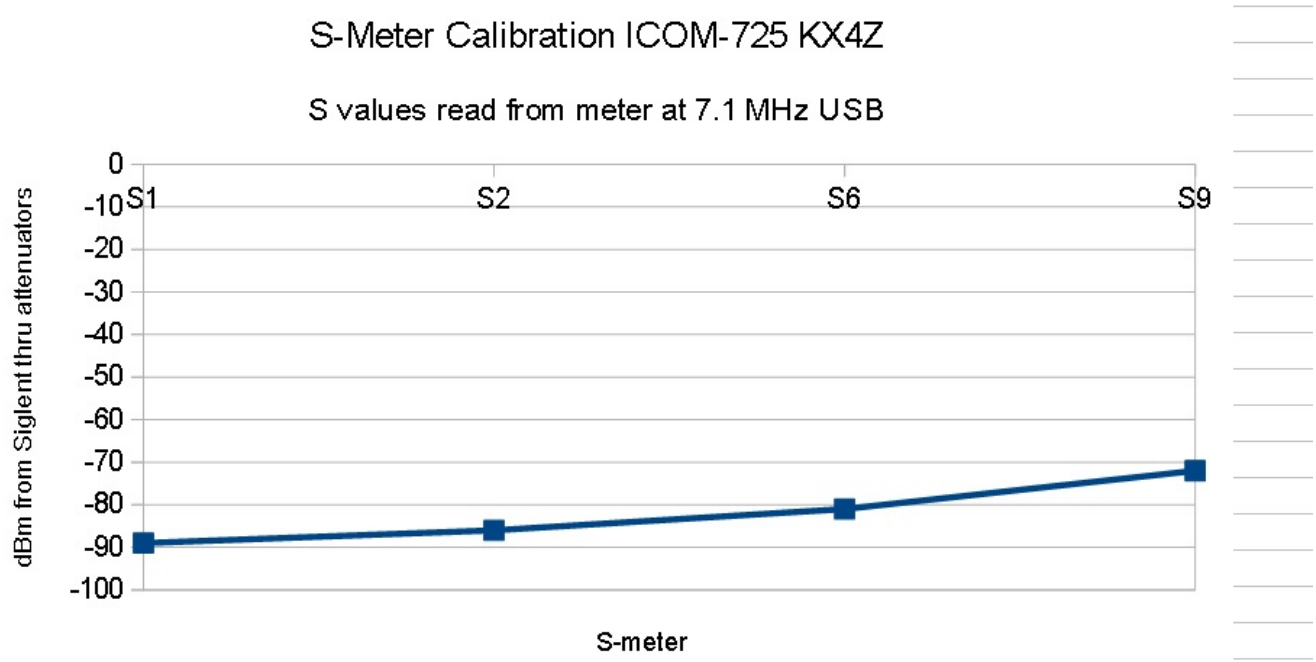
REMOTE LOCATION: (to trigger remote Gateways into sending me emails) trying to get my signal much *much weaker* at my house, I drove about 15 miles westward[41], to the next little town, Newberry, where my post office is located....but I really live between newberry and Gainesville. At a ParkNRide that was deserted, I used a slingshot to put up a 40 meter near-vertical wire antenna (65 feet) and a 1:49 endfed balun that I built last week, with 50 feet of coax to my go-box system, a MFJ intellituner and an ancient ICOM725 with a PTC-IIIusb pacJustor. I set up this antenna and verified

40 The copy and paste failed to capture the graph which is in the published document. I have added it back in from files on my computer.

41 The actual distance appears to be 9 miles after consulting a map.

that I could connect to WW4MSK in the north Ga Mountains on 40 meters, and then drove home to explain all of this to Leland. Once he seemed to udnerstand his jobs, I drove back 15 miles, reconnected to the wire antenna hidden in the trees beside the PARK N RIDE (which was deserted) and we started the test.

Smeter calibration on 7100 kHz of Remote Location IC-725: (method: Siglent spectrum analyzer tracking generator, external physical attenuators, one of which is a dummy load with a tap, measured by the Siglent to be -71 dBm attenuation at this frequency.[42]



3

TEST RESULTS

We worked at it for about an hour. On 40 meters, it was worse than discouraging. Not a single station that I was able to connect to, caused ANYTHING more than 1 or 2 packets to be captured based on what Leland told me over the phone. I was seeing weak, but usable signals of about S1 on the ancient 725. here is a list of the stations I tried;[43]

Impact of Monitoring Location RFI Noise

After I calibrated these two S meters, it is clear that I was making contacts from the Remote Location with signal levels at the receiver in the rante of S1 = -89 dBm.[44] The background NOISE LEVEL at the Monitor location is in the range of -85 dBm --- in other words, unless a

42 The copy and paste failed to capture the s-meter calibration from the published pdf. It has been added back in from files on my computer.

43 This is obviously the record of a real experimental session. These are the results of real amateur radio reception in difficult environments.

44 These are ridiculously weak signnals. Compare, for example, to data here for typical signals: https://qsl.net/nf4ac/2019/GibbyAntennaBaselines042232019/GibbyHouseAntenna181540metertune04232019.jpg showing signals into the -60's dBm.

freak lobe of the Mointor location antenna, or some difficulty with the vertical antenna at the Remote location cause a wide disparity of antenna gains (which can happen) --- the monitor location had a NOISE LEVEL 4 db even above the SIGNALS I was copying at the remote location, and the noise level at the remote location may have been much much lower, since to my ear, I had a S/N ratio of at least 3dB and possibly higher. **In other words, the monitor location, for 40 meters, was severely handicapped. That probaby explains why nothing worked until we moved to 20 meters.**[45]

SYNOPSIS OF ONE HOUR OF TESTING

1518 (3:18 PM) WW4MSK (40 meters) -- north georgia -- S1, decent connectin 1400 bps, moved traffic 7.103 dial frequency -- SSB foreign voices nearby, and leland caught NOTHING.
Tried that again -- lots of repeats, not really working on my end EITHER, aborted.
1527: KQ4ET 10.145 dial -- (I forgot my antenna really didn't work at all on that band....fog of war). No workable connection
1530 AB4NX (Atlnta, 40 meters) 7.101.5 dial, my notes suggest I moved some traffic, but only 600 bps, spanish nearby and leland heard nothing.
1535 WD4SEN about 85 mies away on 40 meters -- no connection at all
1536 soe station on 30 meters -- no connection
1539 WW4MSK on 7.102....S1 unworkable signal, gave up
Note: leland says I am "S8" which means I think that i'm 6db or so above the background noise
Correction: based on the curves measured afterwards, it may be only 4dB or so.[46]
1542 AJ4FW (GA) 40 meters Not working for either of us
1546 N5TW on **20 meters** --- I told leland just to hold off -- good connection!!!
We moved Leland to 20 meters. I had him hit the CW key and TUNE the antenna controller on ONE station -- probably the superior antenna. My station would call immediately on the same frequency, effectively ID'ing for him (he doesn't know CW and nothing connected that could do digital)
Gave up on the Radio Room Station; We gave up on the NCS521 Radio Room receiving system at this point. I doubted that i would be able to timely talk Leland through tuning that antenna up and protect the receiver in the Gateway room. The next morning, I did tune that auto-tuner, and the audio signal level jumped remarkably -- so that station was at a severe disadvantage for the remainder of the test.
4
1549 N5TW 14.105.8 -- good signal from N5TW, reading about S4 on my 725 but very readable. i believe I moved a piece of traffic 2121 unencoded bytes (Retrospect: Don't know if the calibration of the S meter on 20 meters is same as 40, but if it were, this would indicate **approx -83 dBm signal**) [the capture file for that didn't work that I have been able to figure out yet; retrospect: the Monitor location might still struggle mightily with this low signal level][47]
1555 N5TW 14108.5 -- I had sent myself a hurried email from my gmail acccount -- retrieved it on 20 meters 588 unencoded chararacter and it **decoded perfectly and is attached.**
1558 -- I did another file with N5TW but leland says nothing was happening at all on the rapsberry and that made me nervous that the program had stopped, so i talked him through completing the program (Type exclamation point and enter) and backing up the files, which turned out to be unnecessary. I can't find this file anywhere so far in the raspberry files so I don't know what happened.

---

45 Not sure if this was ignition noise, or exactly when I discovered that.

46 So apparently the signal levels across the 9 mile path are not very strong at all....only single digit dB above noise. This is anything BUT a laboratory!

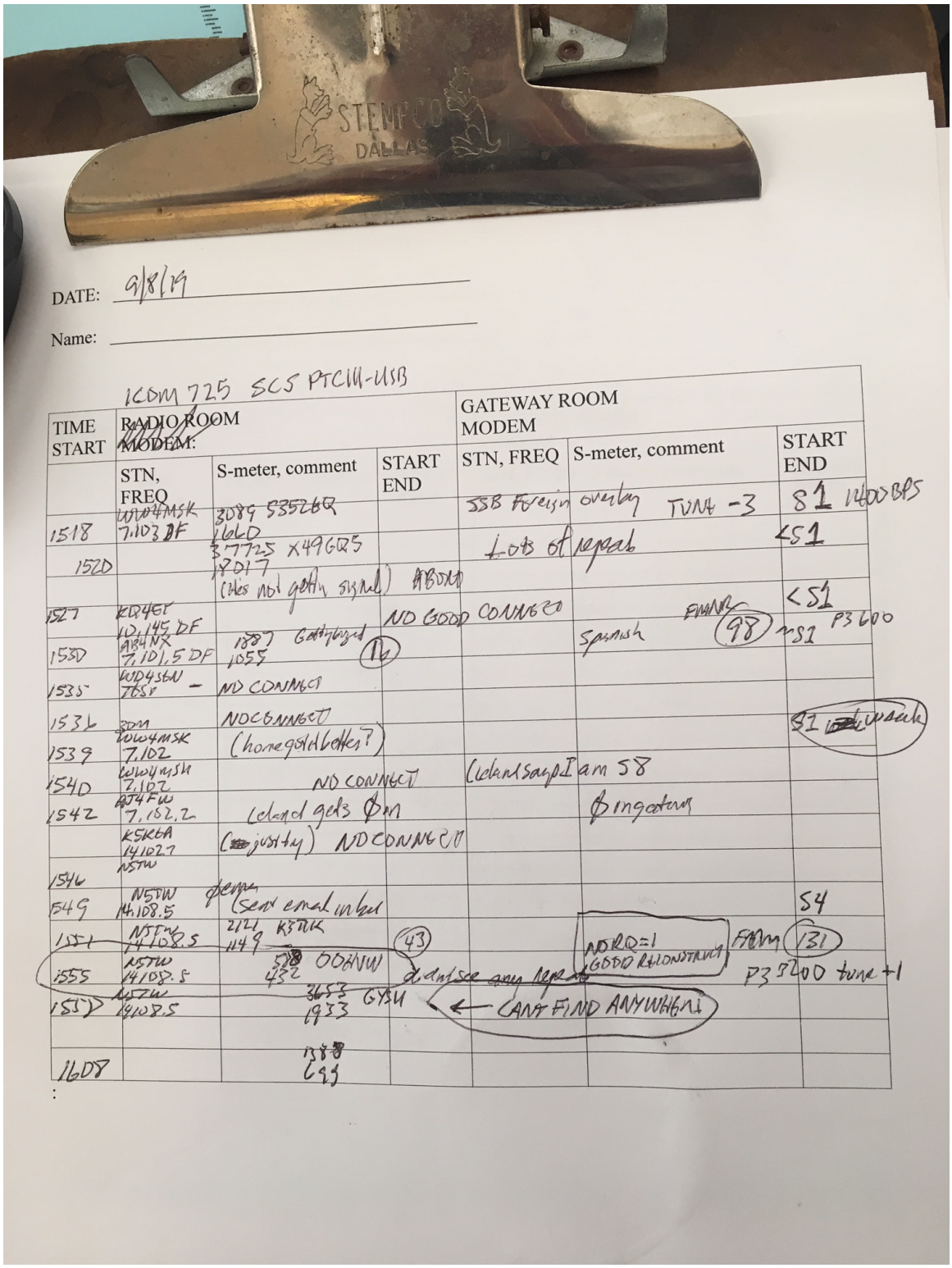
47 Still ridiculously low signal levels, but "very readable" in my perception.

I talked Leland through restarting the program Retrospect: this may have been totally unnecessary; the restart appears to have merely appended to the previous file. The signal levels at the Monitor Location may have just been too low for capture for a period of time.....
1608 i sent RECEIVED another file to N5TW. 1388 uncompressed; a portion of this was captured in a capturefile and looks like it should uncompress but i haven't succeeded yet.
When I got home, I'm a little confused by the files captured, but I was able to completely reconstruct the email that was downloaded at 1555. The capturefile and the reconstructed text for that are attached.
So a grand total of 1 email perfectly captured for an hour's work. A bunch of stations on 40 meters with really weak signals, usable at my remote location, by not usable at my house apparently.....
Lessons:
1. I think the ParkNRide in a desolate outskirts of small town has much lower noise than my house and i was making connections that didn't even budgt the modems at my house -- where you can hear "frying pan" noise continuously in the daytime. **1 day later: Confirmed through calibrating the respective S-meters.**
2. Getting a GOOD SIGNAL seems much more important than distance. N5TW is almost a thousand miles from me, but he was BY FAR the only really strong signal that I ever connected to in the entire hour. Comment; even with N5TW we were working with relatively weak signals....-83 dBm likely.[48]
3. This was, in my expeience, the MOST DIFFICULT TIME OF THE DAY to make any winlink connection. The North Florida ARES people learned the hard way that 80 meters is almost useless at that time of the day, in a recent small exercise that Dave Davis conducted with Karl Martin (SEC)
4. I suspect I would have MUCH better success at night, when my solar power shuts down. Still, I cannot get my house to be nearly as RF Quiet as i would like.
5
5. **With a STRONG better signal, we had excellent capture on the PMON on the better antenna rig.** So YES -- it does work with a sufficiently strong signal from a station almost a thousand miles away and on 20 meters. *But we didn't get EVERY email by any shake of the stick* and work will need to be done to figure out what are the issues and whether they can be optimized. I may or may not be able to complete that optimization.... **but getting ONE PERFECT EMAIL on the first day of trails in the first HOUR of such trials, was certainly ENCOURAGING**.
6. Another item: I enabled the PMON to give me "repeat" ("request") packets also --- there are PLENTY of those captured at various times in the 38 kilobyte capture file (which I can send anyone). My theory was to start getting this data NOW because if i can adapt the software to take advantage of repeats where needed, i'll make it a far stronger monitoring system.[49] However, the only file that succeeded today happened to have zero repeats at all, over a 1000 mile track.
Retrospective comment: The capture file reveals that the monitor station detected no retries for that transfer! Estimated signal level -83dBm (based on 40 meter calibration of S-meter) and perfect capture with no retries. Fairly impressive modem!![50]
REQUEST PACKETS: The major portion of the (short) capturefile for the RADIO ROOM receiving setup is also included below -- and reveals that for one brief period, it was capturing original packets when the trigger remote station in Newberry was needing REPEATS. --- Allows you to see how dicey the reception was and variable between the two stations[51]....just a moment later, the RADIO ROOM station completely misses two packets (which the Newbery remote trigger station apparently got

48 Note the extremely weak signals, and my comment that getting a good signal is the main requirement.
49 Obvious potential improvement!
50 These modems are amazing to me. That we now have reasonably similar performance from a raspberry pi and soundcard is amazing.

because the message did go through.[52]
So --- capturing off the air signals on 20 meters is definitely POSSIBLE and worked FAR BETTER (on 20 meters) for me today, in the heat of the day, than 40 meters where my house is at a very severe noise disadvantage. There are two other messages with partial packets and I'll need to sit and ponder over them a bit to see what I can learn from them. I am unable at this time to make any real conclusion if there is any significant difference between my pactor modem and the one being loaned to me. At least the one being loaned DOES WORK.
I'm enclosing a photo of my data capture sheet[53], and two important files. In my experience, taking a photo of lab notebooks taken in real time during an experience has been incredibly useful later on.....
My next chance to work further on CAPTURE will not come until TUESDAY. Not sure what I can do then, but I'll churn through this data and see if I see any improvement or test that needs to be done.
I'm working on getting more people to help me.
Gordon Gibby KX4Z
6
7
8
9

51 This is a foreshadowing of the obvious benefits of diversity receiving which would later be formally demonstrated in later filing.
52 These are obviously real conditions, with fading.
53 This image did not properly copy and paste...I have added it back in from stored files.



NOTE ADDED DEC 7 2019: Although the printed headings of this sheet suggest it was used at the home station, it was actually filled out on Sept 8 2019 in the deployed pickup truck station, recording only the efforts of the intended recipient to make monitorable Winlink connections. .This is obvious from examing pages 4-6 of

https://www.qsl.net/nf4rc/Tech/RaspberryPiWinlinkDecoder/0908/CAPTUREPRACTICE001.pdf , the linked experimental report listed in the published FCC filing; see link printed on page 22 of the filing: https://ecfsapi.fcc.gov/file/109191626613689/InconvenientTruths.pdf

APPENDIX: Portion of CaptureFile for 1555 Correct Capture:

```
###PLISTEN: Level: 3:
###STATUS: SL: 5, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -21.3, CRC: 0C7F, FRCNT: 3,
FRNR: 134
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: -21.8, CRC: D522, FRCNT: 1,
FRNR: 135
###PAYLOAD1: LEN: 59, TYPE: 0
###PAYLOAD2:
: KX4Z O0HVWTJJHS1W 432 ggibby@anest.ufl.edu Test
FC EM O0H
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -21.9, CRC: 1D12, FRCNT: 2,
FRNR: 136
###PAYLOAD1: LEN: 26, TYPE: 0
###PAYLOAD2:
VWTJJHS1W 588 432 0
F> 4B
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: -21.6, CRC: 370D, FRCNT: 3,
FRNR: 137
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -22.1, CRC: 4792, FRCNT: 0,
FRNR: 138
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -23.0, CRC: 57DD, FRCNT: 1,
FRNR: 139
###PAYLOAD1: LEN: 55, TYPE: 8
###PAYLOAD2:
65,73,74,00,30,00,02,FA,6F,E7,4C,02,00,00,EC,F5,7A,1C,6D,67,6F,79,D4,F1,78,FC,1D,6B
,AB,EE,FE,F6,F3,33,96,C3,F6,80,7C,70,B0,77,D7,F7,1C,5D,DD,28,C0,17,12,9D,1B,1A,3C
###PAYLOAD_END
Ã¾Ãº
10
###PLISTEN: Level: 3:
```

###STATUS: SL: 3, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: -21.6, CRC: 2727, FRCNT: 2, FRNR: 140
###PAYLOAD1: LEN: 57, TYPE: 8
###PAYLOAD2:
1E,05,BD,B7,4B,FD,FB,FC,D3,AB,73,8B,77,DC,87,E7,3D,F5,F7,4E,02,F3,2D,7F,56,7F,FB,4D,D0,0F,CB,F1,2E,F3,E1,2C,F5,D4,6A,18,9A,EB,F9,29,3C,D2,23,BD,6C,DB,ED,27,DE,ED,F6,A3,56
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 4, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -23.3, CRC: F18A, FRCNT: 3, FRNR: 141
###PAYLOAD1: LEN: 112, TYPE: 8
###PAYLOAD2:
88,17,59,A4,14,E1,9B,B8,E1,75,B9,CC,E2,E6,DF,71,8F,0B,7E,CB,2E,C6,1F,49,D9,87,0F,01,2E,2A,94,B0,0F,51,2D,97,99,0A,06,0B,A5,0E,91,B9,F1,12,06,39,94,AA,59,21,F4,82,60,E3,48,90,4C,B9,92,E8,20,54,1C,A9,25,F5,05,D6,A6,24,A9,6F,93,ED,F4,21,14,60,B2,86,24,EF,D2,0E,7F,3E,96,E4,90,F0,41,3E,FF,E8,C1,3A,0B,7F,7E,3F,3D,52,F0,36,73,EE,9E,17,E6,8B
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 4, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: -23.1, CRC: F050, FRCNT: 0, FRNR: 142
###PAYLOAD1: LEN: 118, TYPE: 8
###PAYLOAD2:
DF,F2,94,8E,43,4E,C0,AE,BA,37,F2,59,65,A8,50,39,24,03,3F,A5,28,76,FC,C6,E0,23,0D,E4,3A,9A,DF,38,F8,2F,02,B6,FC,9F,EB,E7,60,03,FA,00,D6,FB,7F,40,D4,2D,48,1D,C3,53,6C,43,7C,B1,65,07,CC,EF,61,96,21,2D,5E,DD,FA,E7,3F,9D,77,6E,2D,EB,0F,7D,67,B0,9E,16,12,0E,66,8C,8E,BA,FB,9B,99,0A,E0,49,9A,DF,DC,AC,59,A3,AB,49,3E,CA,AA,2D,CF,34,D1,F0,9E,4E,35,AF,A3,36,2B,3E
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 4, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -23.7, CRC: CB6B, FRCNT: 1, FRNR: 143
###PAYLOAD1: LEN: 102, TYPE: 8
###PAYLOAD2:
63,BD,9C,2D,C3,DE,CA,93,44,1A,1D,62,44,7B,D4,92,2F,FA,79,C7,C5,C4,E8,A4,DA,53,BF,0B,DE,0A,07,E3,8F,66,2B,BE,D4,F0,DB,E6,82,79,C1,BE,B8,AC,B6,D2,68,58,A4,B5,71,95,0F,AD,47,93,05,88,2B,AF,9D,AA,11,D1,4C,A1,94,B7,E8,A1,DE,69,95,9B,25,95,B0,56,ED,25,4C,96,AB,14,64,C7,7D,E7,6D,35,19,95,74,9F,FC,AC,AE,E0,04,98
###PAYLOAD_END
Ã¾Ãº
###PLISTEN: Level: 3:
###STATUS: SL: 4, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: -24.2, CRC: 4F65, FRCNT: 2, FRNR: 144
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:

11

APPENDIX: Reconstructed Email captured from >900 miles away

MID: O0HVWTJJHS1W
Date: 2019/09/08 19:54
From: SMTP:ggibby@anest.ufl.edu
To: KX4Z
Subject: Test

```
Mbo: SMTP
Body: 463
This is a dictated email so I will have something to test myself. We have finally
gotten a good signal on N5TW. Before that it looked like my home station has a
higher noise level from the solar panel charge controller’s and thus it never got
any signal— when I was getting s1 week but readable signal sitting in the park-
andride
in Newberry Florida.
It looks like N 5TW on 20 m is the station that my home station can actually
monitor.
Sent from my iPhone
```
12

APPENDIX: SNIPPET FROM THE RADIO ROOM CAPTURE FILE

NOTE: You can see the RETRY PACKETS in this capture. Icom 718, 12-to-30 foot sloping dipole; DRAGON 7800 modem; this station was NOT retuned to funciton on 20 meters and effectively was lost to the study at that point.

Comparing the FRAME NUMBERS to the handwritten notes from Leland, all of these packets were copied during the 1531 attemp at a transfer. Distant Gateway AB4NX on 40 meters, with QRM and very low isgnal -- the presence of the REQ 1 packets indicates that even my remote trigger station was needing retries.

cmd:
*** PMON VERBOSE: 3
cmd:
*** PMON HEX: 1
cmd:
*** PMON PACKETS: 1
cmd:
PACTOR-1/2/3 Monitor started:
==========
cmd: ú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: 14.2, CRC: BF00, FRCNT: 1, FRNR: 3
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: 14.7, CRC: C85C, FRCNT: 1, FRNR: 4
###PAYLOAD1: LEN: 5, TYPE: 0
###PAYLOAD2:
EM 4L
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: 14.6, CRC: 797C, FRCNT: 2, FRNR: 5
###PAYLOAD1: LEN: 5, TYPE: 0
###PAYLOAD2:
0ZWCE
13

###PAYLOAD_END
þú
==========NOTE PACKET CAPTURED BY THIS STATION BUT NOT BY THE ACTUAL REMOTE TRIGGER STATION -- BECAUSE IT DEMANDED REPEATS --
==========
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: 15.5, CRC: 440B, FRCNT: 3, FRNR: 6
###PAYLOAD1: LEN: 2, TYPE: 0
###PAYLOAD2:
B
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, **RQ: 1,** REV: 0, LSB: 0, dF: 16.3, CRC: 440B, FRCNT: 3, FRNR: 7
###PAYLOAD1: LEN: 2, TYPE: 0
###PAYLOAD2:
B
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, **RQ: 1,** REV: 0, LSB: 0, dF: 15.6, CRC: 440B, FRCNT: 3, FRNR: 8
###PAYLOAD1: LEN: 2, TYPE: 0
###PAYLOAD2:
B
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
========NOTE MISSING PACKETS 0 AND 1 ==========
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: 14.1, CRC: CF9F, FRCNT: 2, FRNR: 9
###PAYLOAD1: LEN: 0, TYPE: 0
###PAYLOAD2:
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 1, RQ: 0, REV: 1, LSB: 0, dF: 7.8, CRC: 65F5, FRCNT: 3, FRNR: 10
###PAYLOAD1: LEN: 34, TYPE: 8
###PAYLOAD2:
77,F6,D6,7D,2F,F7,EF,F3,4E,A7,7F,17,C1,6F,17,C2,8B,DE,05,65,3A,02,EF,43,62,FB,DD,61,FF,E6,7C,DE,C1,FA
14
###PAYLOAD_END
þú
###PLISTEN: Level: 2:
###STATUS: SL: 2, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: -11.1, CRC: 2147, FRCNT: 1, FRNR: 11
###PAYLOAD1: LEN: 5, TYPE: 6
###PAYLOAD2:
kx4z

###PAYLOAD_END
þú
==========NOTE THE TRIGGER STATION MISSED THIS PACKET -- BUT THE MONITOR STATION GOT IT ON THE FIRST TRY!!! ==========
###PLISTEN: Level: 2:
###STATUS: SL: 2, CYC: 0, RQ: 1, REV: 0, LSB: 0, dF: -11.9, CRC: 2147, FRCNT: 1, FRNR: 12
###PAYLOAD1: LEN: 5, TYPE: 6
###PAYLOAD2:
kx4z
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 1, LSB: 0, dF: 1.1, CRC: BBFD, FRCNT: 1, FRNR: 13
###PAYLOAD1: LEN: 0, TYPE: 6
###PAYLOAD2:
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: 2.4, CRC: 8966, FRCNT: 2, FRNR: 14
###PAYLOAD1: LEN: 0, TYPE: 6
###PAYLOAD2:
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 1, REV: 1, LSB: 0, dF: 3.1, CRC: 8966, FRCNT: 2, FRNR: 15
###PAYLOAD1: LEN: 0, TYPE: 6
###PAYLOAD2:
###PAYLOAD_END
þú
###PLISTEN: Level: 3:
###STATUS: SL: 1, CYC: 0, RQ: 0, REV: 0, LSB: 0, dF: 8.4, CRC: 98EF, FRCNT: 3, FRNR: 16
###PAYLOAD1: LEN: 0, TYPE: 6
###PAYLOAD2:
###PAYLOAD_END
15
þ cmd:
cmd:
cmd:
cmd:
cmd:
16